The history of fauna conservation in the State Forests of New South Wales

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ABSTRACT

This paper gives an account of the development of fauna conservation as a positive requirement of forest management in the State Forests of New South Wales from the 1970s to the present time. Wildlife management was not part of the forestry curriculum in the 1950s and it was assumed that if the botanical composition of the forest was maintained then the fauna would also be conserved. As the intensity of forest operations increased, particularly with respect to woodchip operations and the establishment of large areas of pine plantation, serious environmental questions began to be raised. The general absence of knowledge about forest fauna and their habitat requirements led to the appointment of a Forestry Commission wildlife ecologist in 1975 and a dramatic increase in research in collaboration with the Australian Museum, National Parks and Wildlife Service, CSIRO and the universities. There has been a steady accumulation of knowledge to the present time and some of the difficulties in the implementation of this information are discussed. The increase in knowledge has led to a variety of interpretations some of which seem to be based more on values than science. During this period, there were many conflicts over forest practices which obscured the great progress that had been made. There have been recent developments with government inquiries and political innovations resulting in the National Forest Policy Statement, the development of Regional Forest Agreements, and new forest legislation, including the regulation of forestry on private lands. With the Comprehensive, Representative and Adequate reserve system now in place, and sophisticated fauna protocols in use in forest operations, we can be optimistic about the conservation of the forest fauna providing long-term research and monitoring are continued. However, the pendulum may have swung too far and questions about regeneration techniques, fire exclusion policies and the viability of the native forest timber industry are also raised.

Key words: fauna conservation, environmental history, harvesting protocols, New South Wales State Forests, forest policy, woodchipping, rainforest logging, silviculture.

Introduction

Dan Lunney asked me to prepare a paper on my experience, as a forester, on the development of fauna management as a feature in modern forest management systems in New South Wales (NSW). Dan was fully aware, of course, that such reflections on my part would tend to raise once again many of the tensions and stresses that dominated our professional lives during the period from the 1970s through to the new millennium. I have no doubt that many of the issues will continue well into the future, despite the large amount of excellent research that has been undertaken in the intervening period, the large increases in the area of the conservation reserve system and the development of protocols to maintain habitat and fauna within multiple use forests.

At the outset I state that I am an old and conservative forester. Therefore my attitudes should not reflect on the new generation foresters whose training has been more multidisciplinary in accord with the current demands of society.

As I see it, one of the main reasons for continuing conflict in this and other aspects of the environmental debate, is that scientists, and others, are still having great difficulty in separating their value systems from scientific evidence. While this can be said about all sides in the environmental debate, I believe that strict adherence to the null hypothesis approach by scientists is still a commendable self-discipline. It is also imperative that there is a free exchange of data, ideas and opinions so that alternative interpretations can be examined (Recher *pers. comm.*). Miller (1985) discussed the prevalence of psychological biases in the interpretation of environmental data that do need to be recognised. On the other hand there are arguments that this is an inevitable situation (Andren 1991) and we are all susceptible. Probably the most important factor is that sufficient time must elapse so that long-term experiments can provide more confident (and objective) evidence of trends with respect to the recovery and maintenance of wildlife populations in disturbed forest systems. Unfortunately long-term experiments are expensive to maintain and many organizations involved in research seem to be abandoning these in favour of short-term work funded by commerce. Some valuable long-term experiments have been overtaken by changes in land use, such as the transfer of State Forest to National Park, or even within a National Park by dedication as wilderness area (Recher 2002).

Naturally I will try desperately to be objective in outlining my recollections of the history of past issues involving the conservation of forest fauna. In doing so, I am becoming aware that history itself is capable of many interpretations

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and many historians now argue that there is no such thing as an objective truth (see the heated debate about history, including Aboriginal history in Spectrum, *Sydney Morning Herald*, August 17-18, 2002 under the title "In the right corner…"). Frawley (1988) gives some insight into approaches to forest history and Legg (1988) would classify my memoirs as "the orthodox response to the challenge of the environmental movement", which may well need to be rewritten in the future. Nevertheless this is the way I remember it. Forget the science. Let's get on with the story! The location of various areas, towns, State Forests, and National Parks in this rambling story is shown in Fig. 1.

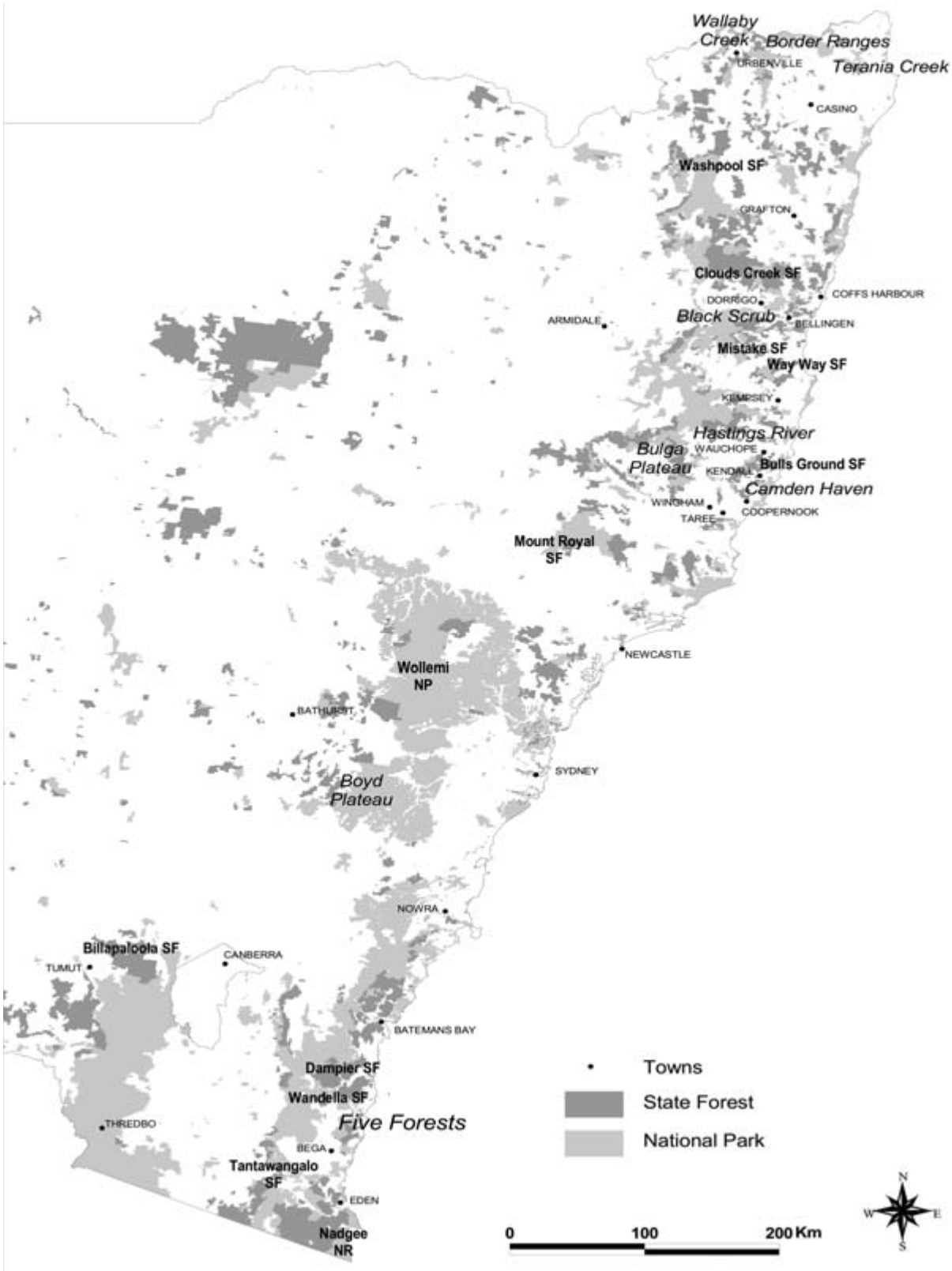

Figure 1. Map of New South Wales showing the locations mentioned in the text. (Map prepared by the GIS unit of State Forests).

Early recollections

I commenced my university course in 1949 as a Forestry Trainee, so that university vacations were usually spent getting field experience with the Forestry Commission of NSW. I had little knowledge of native fauna, although I was involved in some hunting activities. In this and subsequent sections, I will outline the slow development of knowledge arising from personal involvement. In early 1950 our small group of trainees were engaged in what was to be later described as that "terrible" activity known as clearing for the establishment of pine plantations in the Tumut area in southern NSW (Billapaloola State Forest). We used axes and cross-cut saws, but reluctantly I admit that we got some entertainment out of watching the Greater Gliders *Petauroides volans* volplane to the ground, climb the next tree, only to have it cut down again. I did not give much thought to the survival of the gliders, because it seemed to me that there was a lot of similar forest still available to them. The important work of Tyndale-Biscoe and Smith (1969) had not yet been undertaken. This demonstrated that these animals did not survive once their home range was destroyed. Unfortunately I did not become aware of this work until the mid 1970s.

In 1950, myxomatosis had not yet been introduced to control the rabbit population and the density of rabbits in the general pastoral area around Tumut was amazing. I was to later witness this pastoral landscape change dramatically from brown and dusty to green and relatively luxurious as the rabbit population declined.

After completing the first two years of the science course at the University of Sydney (with courses in botany but unfortunately not zoology), we commenced a full year of field training which was spent in many parts of the state. 1951/52 was a long, severe fire season, so we finished our field year as very experienced firefighters. I was always impressed by the large numbers of animals seen attempting to escape from the fire front. As trainees we were involved in further "crimes" at Acacia Plateau on the Queensland border near Urbenville by clear falling subtropical rainforest for the establishment of Hoop Pine *Araucaria cunninghamii* plantation. There were large numbers of pademelons *Thylogale spp* and I captured a young one and kept it as a pet at the campsite for a short time. Incidentally the clearing of the relatively small area of rainforest for hoop pine planting commenced in the 1930s in order to prevent much larger areas of forest from being alienated (i.e. selling crown lands to private owners) and subsequently cleared for dairy farming. Conservation can and does work in mysterious ways.

During 1952 and 1953, I completed my formal training at the Australian Forestry School in Canberra. While this training was very comprehensive, I have no recollection of fauna conservation being part of the curriculum. However, I was certainly aware that the early European forester was often regarded primarily as the gamekeeper for hunting expeditions by aristocrats and royalty.

On graduation I was posted to Taree in 1954 and started on the work I loved; i.e. the management and silviculture of the eucalypt forest. While undertaking an inventory in Coopernook State Forest (just north of Taree), I was amazed that one of the bushmen helping me, refused to drag the survey chain on a compass line through a stand of Swamp Mahogany *Eucalyptus robusta* because of the danger from black snakes. Our survey party certainly did see more snakes than usual on this part of the survey. Of course in those days you did try and kill any venomous snake you came across! My environmental ethics had still not fully developed.

There was a beautiful second growth stand of even-aged Flooded Gum *E. grandis* in the Pipeclay Creek area of Lansdowne State Forest near Coopernook which had originated from the harvesting along the old tramway system constructed from Langley Vale in the early 1900s. The District Forester (Frank Bailey) suggested that part of the stand near an old dam be preserved for aesthetic reasons. Unfortunately the log quality was not good and I successfully argued that we should regenerate the stand by clear falling in order to improve its quality and productivity. I did regret that decision later, but anyone who visits the area now will be impressed by the beautiful third growth flooded gum stand which now occupies the site. In the same area there was a large flying-fox camp in a mixture of Bangalow Palm *Archontophoenix cunninghamiana* and Flooded Gum. At that time (1956) there was no interest in determining whether the harvesting caused the camp to break up. Indeed the residents of the nearby town of Wingham were unsuccessfully trying to rid the town of its resident flying-foxes. However, I was becoming more ethical as time passed because I always rejected offers to eat scrub turkey.

I was generally aware of the larger animals and birds in the forest. Possums, echidnas and wallabies were quite common. Koalas *Phascolarctus cinereus* were occasionally seen and when disturbed in a logging area they were transported and released at another location nearby. I used to see platypus *Ornithornhynchus anatinus* near the camp on the Bulga Plateau to the west of Taree. I was fascinated by the mimicry of the lyrebirds when marking trees to be removed in later logging operations. The occasional quoll *Dasyurus maculatus* was seen. In the 1950s bandicoots were common on some of the vacant residential land in the town of Taree but I never see them now in my visits to this magnificent town.

The idyllic 1960s

In 1960 I commenced my career in silvicultural research and later undertook post-graduate studies at Melbourne University from 1962 to 1965. During this period, I was unaware of any major concerns with respect to conservation. On returning to Taree (and the north coast of NSW) there was increasing emphasis on harvesting the old growth forests of the escarpment country, the establishment of Flooded Gum by sowing and the commencement of jiffy pot planting of Blackbutt *E. pilularis*. The TSI (Timber Stand Improvement) Program, which consisted of the felling or ringbarking of overmature non-commercial trees within recently harvested forest, was a major feature in improving

the timber productivity of the forest, but this was also reducing the structural diversity of the forest. There appeared to be little public interest in environmental or conservation matters related to forest management. At that time there was considerable concern with sand mining which was now being undertaken on the north coast on a large scale. The profession of forestry was remarkable by the fact that most people were unaware of, and uninterested in, what the forester actually did. As far as the profession was concerned, it was essential to regenerate the forest after harvesting, usually without altering the dominant species association (although Flooded Gum establishment did extend to some rainforest gullies and some other species types and this was to lead to significant criticism in the 1970s). Foresters considered that the forest environment and ecosystem functions would continue basically unchanged. The earlier crown dieback problems associated with high altitude rainforest harvesting had been overcome by reducing the intensity of logging, but overcutting was still occurring. Efforts were being made to reduce the annual volume of timber harvested in both rainforest and hardwood forest to a sustainable level, although there were political difficulties in achieving this. These difficulties included the high demand for timber because of post-war reconstruction efforts, as well as possible political patronage of influential timber companies. There was a tendency by government to exploit the native forest as an interim process while waiting for the increasing production from pine plantations to make up for future shortfalls. This tendency was reinforced on a national scale by the Commonwealth Forestry Agreement (1966) which made federal funds available to participating State Governments for a large increase in pine planting.

As well as an increasing emphasis on old growth logging, rainforest logging, and the clearing of native forest for the establishment of pine plantations, there was a silvicultural need to improve the productivity of large areas of lower quality eucalypt forest with less desirable species for sawlogs such as occurred in the south-east forests near Eden. The ability to sell poor quality logs from the forest improves the economics of harvesting, and the cost of subsequent silvicultural treatment. Consequently the availability of a market for pulpwood was of great importance to forest management. The Eden area had originally been studied by Australian Paper Manufacturers Pty Ltd (APM) in 1934 as a possible site for a pulpmill based on the south-east forests, but the paper company finally chose Maryvale in Victoria. It was not until late 1969, after much negotiation by the Government, that an agreement with Harris Daishowa was reached and the harvesting of woodchips commenced in the Eden forests. This harvesting was on a large scale (up to 5000 ha per year or 2% of the total forest area) and initially not widely dispersed until sufficient roading had been constructed. The first shipload of woodchips was exported in 1971. This intensive operation, in conjunction with concern over the establishment of pine plantations, and the logging of rainforest, were the catalysts in awakening popular interest in the environment and it meant that those idyllic, peaceful days were over for the forestry professional.

The gradual awakening 1965-1975

Publication of "The Silent Spring" by Rachel Carson in America in 1961 was probably the start of the modern environmental awakening. Within Australia, we had the publication of "Flying Fox and Drifting Sand" by Ratcliffe as early as 1947, "The Great Extermination" by Marshall in 1966, followed in 1973 by "Wildlife Conservation" by Harry Frith. No doubt "The Fight for the Forests" by Routley and Routley (1973) was a radical and influential demand for change in forest policy and management and contributed significantly to growing opposition to pine planting and woodchip operations. Also important were the Report of the National Estate (The Committee of Inquiry into the National Estate 1974) and the establishment of the Australian Heritage Commission in 1974.

The National Parks and Wildlife Service was established in 1967 and started a program of extending the area of reserves in NSW. The total area of reserves in 1966 was only 814 000 ha (Reed 1991) and much of this (in common with the earlier reservations of State Forest) was considered to be not useful for any other purpose (the "worthless lands hypothesis", Hall 1988). In 1971, the Institute of Foresters of Australia organised a conference at Thredbo with the title "Man and his Forests: Conservation and Multiple-Use Policies" which was addressed by the Director and Assistant Director (Wildlife) of the National Parks and Wildlife Service (McMichael 1971; Steele 1971). Don McMichael generally addressed the ability of the Service to provide for recreation, wilderness and scientific reference areas in a well reasoned approach, while Bill Steele specifically addressed the demand for wildlife management indicating that the dual roles of managing forests and parks should not lead to major problems.

In 1972 the Forestry Act was amended to define the objectives of the Forestry Commission that included:

- to conserve and utilise the timber on Crown-timber lands.....
- to provide adequate supplies of timber from Crown-timber lands.....
- consistent with the use of state forests for the purposes of forestry and of flora reserves for the preservation of flora thereon –
  - (i) to promote and encourage their use as a recreation; and
  - (ii) to conserve birds and animals thereon.

These objectives were included in the Act in recognition that, in addition to the demand for forest products, there is a "human need for the non-material values intrinsic to a forest environment such as catchment protection, wildlife habitat, natural scenic values and preservation of the scientific values of forest communities" (Forestry Commission 1976).

While these Section 8A objectives can be interpreted readily as embracing the concepts of Sustainable Forest Management, they also affirmed the traditional multiple use approach to forest management and this has caused a considerable amount of criticism concerning the concept of "the primacy of wood" in which conservation objectives were considered to be secondary constraints to sustainable timber production (Davey and Norton 1990, Florence 1993).

Within the Forestry Commission, special mention needs to be made of George Baur, who was the Senior Silvicultural Research Officer during this period. George was ahead of his time when, in1965, he started the Forest Preservation Program with the objective of setting aside small representative areas of undisturbed forest types as scientific reference areas (Forestry Commission 1989). The Forestry Act had been amended in 1935 to provide for the declaration of Flora Reserves, but progress had been slow up until 1965. Since that time, these preserved areas have become important samples of diversity and many have now been transferred to National Parks.

George also published one of the first papers specifically dealing with conservation in forest management (Baur 1968). In 1972, he submitted evidence on behalf of the Forestry Commission to the House of Representatives Select Committee on Wildlife Conservation. In that submission, it was noted that there were no professional wildlife experts in the employment of any Forest Service in Australia, although I have recently been advised that Per Christensen had started his exceptional career in wildlife management for the Western Australian forestry department in Manjimup as early as 1968 (H. Recher; P. Jones *pers .comm.*). George was also the Chair of Panel 3 (Multiple Use of Forest Resources) of the FORWOOD Conference and the need to appoint Wildlife Officers within Forest Service organizations was further reinforced (FORWOOD 1975).

The FORWOOD report proposed that the wildlife officer should:

- provide liaison between the forest service and research workers and propose suitable research projects
- evaluate impacts of forest operations and how they could be reduced (or enhanced if the impacts were beneficial)
- advise on the control of hunting where this was permitted
- advise on pest control

The report urged forest managers to prevent the elimination of any species as a result of forest operations and to promote and fund the required ecological research.

George Baur also authored an excellent public relations book called "A Bit about the Bush" (Baur 1972). It was obviously written well before the publication date as it contains only a small section on "Forestry and Conservation" and that basically extols the virtues of "multiple use".

From 1968 onwards both Harry Recher (then at the Australian Museum) and George Baur were members of the Scientific Committee set up to advise the Minister (Tom Lewis) who was responsible for the National Parks and Wildlife Service at this time. Harry also began undertaking faunal studies in the south-east forests at this time, which expanded to include forestry issues, including a section of the W.D.Scott Report published in 1975, which was the precursor of the first Harris Daishowa EIS in 1977 under Commonwealth legislation. About 1974, the Forestry Commission commenced talks with the NPWS, Australian Museum and CSIRO about collaborative research at Eden. Harry Recher, Dan Lunney and Heimo Posamentier had been undertaking their research on the small mammals in Nadgee Nature Reserve near Eden since 1969 and their study sites had been burnt by the wildfires of 1972. Harry gave a seminar on this work to the Commission staff at Head Office in March 1974 and without doubt this was the first time that most of the FC staff had even heard of *Antechinus*, let alone heard about the amazing breeding cycle of these tiny mammals.

George Baur had recommended the appointment of a wildlife ecologist to the Forestry Commission in late 1972, but apparently there were more urgent staff needs. I had been transferred from Taree to Sydney in 1973 as Senior Silvicultural Research Officer, as George was now involved in establishing the new Community Affairs Branch. The proposal for a wildlife ecologist was submitted to the Public Service Board in June 1974 and Wyn Rohan-Jones was appointed in July 1975. This position had to be swapped for a forester position. Wyn was a practical surveyor of wildlife who was able to train others across the State in the labour intensive tasks of wildlife census. Shortly afterwards Jim Shields and Rod Kavanagh were appointed with Wyn to form a wildlife ecology research unit at the Wood Technology and Forest Research Division at West Pennant Hills. Again there was a shortage of positions and some years elapsed before they achieved their appropriate professional status. Both Rod and Jim are still performing excellent work with State Forests of NSW (formerly the Forestry Commission). With guidance from Wyn and assistance from numerous others, it was not long before Forestry Commission field staff in research and administration had commenced studies in their own regions. Some of the work undertaken involved post-graduate studies.

Some early studies 1965-1975

Significant early work on forest fauna had been published in scientific journals, including studies of the macropods of Wallaby Creek near Urbenville (Calaby 1966), and the loss of Greater Gliders in clearing for plantations near Tumut (Tyndale-Biscoe and Smith 1969). Some pioneering work on the impacts of fire and forest practices on forest fauna was also underway in Victoria (Cowley *et al.* 1969; Cowley 1971; Leonard 1970; Heislers 1970, 1974).

The Forestry Commission sponsored a research scholarship in wildlife ecology at the University of New England (UNE) in Armidale from 1965 to 1972 (How 1972), although it must be admitted that the motivation arose from the damage being caused by two species of Brushtailed Possum *Trichosurus vulpecula* and *T. caninus* in pine plantations established on clear-felled areas of rainforest and wet sclerophyll at Clouds Creek SF on the Dorrigo Plateau in northern NSW. Bob Harden of the NPWS was undertaking his studies on the ecology of dingoes in the Armidale area for the NPWS at this time. The Forestry Commission also encouraged work on the occurrence of birds in the plantations of the Bathurst region (Disney and Stokes 1976). Quite a lot of faunal research was undertaken in and adjacent to pine plantations as a result of the "biological desert" label coined by the Routleys. A scholarship at the UNE was also awarded to Urbenville

forester John McCann to undertake studies on the macropods of Wallaby Creek, but this study was unable to be completed for personal reasons. In January 1973, the Institute of Foresters of Australia (IFA) persuaded the Forestry Commission to fund a short-term study on the effect of rainforest logging on birds at Wiangarie State Forest (Pattemore and Kikkawa 1975).

To put these matters in perspective I should point out that this history of fauna investigation will not attempt to describe the huge amount of early and current ecological work which has been undertaken by the Forestry Commission and others on forest insects, soil fungi and plant pathogens, which had its origins in NSW long ago (Froggatt 1894). Also before and during this period, the importance of forest recreation and soil erosion had also been emphasised. The Forestry Commission had been undertaking research in forest hydrology in collaboration with the University of NSW since 1963. Peter Cornish was appointed as Forest Hydrologist in 1973. Those management systems which had already been implemented to control erosion and maintain water quality, such as unlogged streamside reserves, were later to prove to be very valuable in providing residual habitat in areas disturbed by logging.

Annual reports and research reports 1972-1976

I have examined the Forestry Commission's annual and research reports during this period in order to assess how relevant the environmental and conservation debate had become. For example, the 1972 annual report was the first to mention topics such as wilderness and preservation (admittedly in just a few sentences) stating a preference for multiple use rather than these single use issues. The 1973 report noted the amended objectives in the Forestry Act, progress with the Forest Preserve programme, and that construction of the Imlay Road (providing major forest access in the Eden area) had commenced.

The 1974 report briefly mentioned the need to restrict pine planting to previously cleared land and to conserve wildlife. In contrast the 1975 report introduced a new section on "Environmental Matters" which highlighted the Government decision not to plant pine on the Boyd Plateau near Bathurst after consideration of an EIS. The 1975 report also discussed issues relating to integrated harvesting at Eden. It was noted that the lack of roading had concentrated initial harvesting into the closer coastal forests. The impact of this period of logging was exacerbated when areas burnt by severe wildfires in 1972/73 were salvage logged and this was followed by significant erosion.

The 1976 report announced the start of wildlife research by the Commission in collaboration with the Australian Museum, the start of the Senate Enquiry into the Woodchip Industry, and the Border Ranges rainforest dispute. As expected, later annual reports mention the escalating problems being experienced with the management of the forests, including such matters as public protests in the forest.

The Commission research reports at this time usually covered a two year period. Progress with Ric How's study of the Brushtailed Possums at Clouds Creek SF was discussed from 1968 until its completion in 1972. The report for 1973 and 1974 noted that environmental research was now very important and that research grants had been made for studies in hydrology and animal behaviour. For the first time the report had a section devoted to animal ecology with progress reports on bird populations in logged rainforest, the macropods of Wallaby Creek, and systems to avoid wallaby damage in eucalypt plantations. After the Wildlife Ecology unit was established in 1975, subsequent research reports highlighted progress with the rapidly increasing numbers of wildlife projects being undertaken by Forestry Commission staff, Australian Museum, CSIRO, National Parks and Wildlife Service, universities, and other collaborators.

In summary, it might be said that between 1965 and 1975 the Forestry Commission had commenced along a path of upgrading its commitment to the faunal aspects of multiple use forest management, but it had been relatively complacent about the depth of public concern over a number of environmental issues including fauna conservation. In common with most other organizations, there was a considerable lack of knowledge about the forest fauna and its habitat requirements, although an excellent review of the effects of forest practices on fauna was published by CSIRO scientist John McIlroy in 1978 (McIlroy 1978). Nevertheless the Forestry Commission had started its valuable collaboration with wildlife scientists from various institutions and this was to lead to a dramatic increase in knowledge about effects of forest management on fauna populations. Unfortunately it did not lead to any lessening of public concern and the increase in knowledge led to a multiplicity of recommendations with respect to forest management, not all of which were feasible. This history of faunal forest management in NSW is probably quite similar to developments in the other States at the time.

The accumulation of knowledge 1975-1986

From 1975 to 1986 and beyond there was a great deal of survey and research undertaken on the fauna of NSW forests. As outlined above, the Commission's wildlife unit teamed with Harry Recher's unit at the Australian Museum in order to undertake investigations in the Eden woodchip area. Scientists from CSIRO and the Museum continued their work in Nadgee Nature Reserve to study the responses of fauna to wildfire. In 1977, Wayne Braithwaite of the CSIRO commenced his important studies of the Eden fauna. Numerous excellent publications came out of these studies and it is hoped that many more will be published in the future as the longer term monitoring of both habitats and their fauna continues. Some of the earlier relevant reports included Newsome *et al.* 1975; Recher *et al.* 1974, 1975, 1980, 1981; Braithwaite 1983; Braithwaite *et al.* 1983, 1984; Kavanagh and Rohan-Jones 1982; Kavanagh and Recher 1983; Kavanagh 1984; Kavanagh *et al.* 1985; Shields and Recher 1984; and Shields *et al.* 1985.

In the meantime, controversy continued over integrated logging for sawlogs and pulpwood with attention focussing on the " Five Forests" area near Bega. In 1977, the NSW Cabinet directed the National Parks and Wildlife Service to investigate and report on the impact of integrated logging on the fauna of these forests. This study was carried out (and I understand is still being carried out) by Dan Lunney and his many co-workers. The numerous reports and publications arising from the studies included Lunney 1982, 1983, 1987; Lunney *et al*. 1985, 1986a, 1986b.

At this stage I was becoming increasingly aware of the differences between the values or ethics of scientists and the interpretation of their research data. Of course similar statements could be made about me. I know that Dan Lunney still recalls some differences of opinion with me over the interpretation of some of the results of their very interesting studies of the White-footed Dunnart *Sminthopsis leucopus*. To me, the data demonstrated that this small mammal thrived on disturbance from logging, but Dan described the response in a more oblique manner. Nevertheless, I consider that great progress was being made with our knowledge of the impacts of logging, drought, and fire, and our need and willingness to modify our harvesting practice in the light of this new knowledge. The research was indicating which species were being affected and their dependence on particular habitat features such as mature hollow bearing trees, particular forest types, and the nutritional quality of tree foliage. In the Eden area, existing and newly adopted procedures to protect streams from soil erosion were found to be beneficial, new wildlife corridors were planned, particularly utilising the monkey gum *E. cypellocarpa* flats, and hollow bearing trees retained as habitat (Dobbyns and Ryan 1983).

In general, I think this was a time of great co-operative achievement and refer to the excellent articles on the progress being made which were published in the Forestry Commission magazine "Forest and Timber" at that time (Rohan-Jones 1981,1982; Shields 1982; Kavanagh 1983; Webb 1982, 1983; Lunney 1983; Dobbyns and Ryan 1983; Braithwaite 1986).

In May 1982, the 52nd Congress of ANZAAS was held at Macquarie University in Sydney. Section 11 Zoology held a two day symposium on forest ecology with 11 papers on wildlife covering such topics as arboreal mammals, birds, small mammals, lizards and invertebrate fauna in eucalypt, pine, and rainforest. At that time, it was an excellent review of the work in progress and the available results.

The late 1970s to mid 1980s saw important research being undertaken by such people as David Milledge (Australian Museum) working on Dick Smith's Camden Haven Wildlife Refuge and the adjacent State Forest near Kendall, UNE postgraduate Allison Dunning - arboreal mammals and reptiles (Wauchope Area), Stuart Davey-ANU postgraduate- arboreal marsupials of the Batemans Bay area, Simon Ferrier-UNE- Rufous Scrub-bird *Atrichornis rufescens*, Felix Schlaeger-UNE- Rufous Bettong (rat kangaroo) *Aepyprymnus rufescens* and Long-nosed Potoroo *Potorous tridactylus* of northern NSW, Will Osborne-fauna of the Washpool area, Glen Holmes-National Parks and Wildlife Service-birds of northern NSW, Peter Jarman-UNE-macropods of Wallaby Creek, G. Borgia-University of Maryland-ethology of the Satin Bower-bird *Ptilonorhynchus violaceus,* and forester Charlie Mackowski completed his excellent study on the development of hollows in blackbutt at the UNE (Mackowski 1984). It was during this period that the Hastings River Mouse *Pseudomys oralis* was rediscovered in NSW in the Forbes River area near Wauchope by Linda Gibson of the Australian Museum. All of these studies contributed greatly to our knowledge of the fauna of the NSW forests. The timber industry through the Associated Country Sawmillers was also assisting at this time with the funding of ecological research at universities by participating in a dollar for dollar contribution with the Government.

Over the years the Wildlife Research Unit has been staffed by a number of dedicated and productive research workers including Wyn Rohan-Jones, Rod Kavanagh, Jim Shields, Gary Webb, Ron Haering, Alan York, Frank Lemckert, and Brad Law, with wide-ranging expertise embracing birds, mammals, gliders, owls, herpetofauna, invertebrates, and bats. Staff involved in country regions included Doug Binns, Ian Barnes, Col Nicholson, Charlie Mackowski, Gary King, Dick Turner, Steve Wallace and Ian Johnson.

The publication of research results by forestry staff began in the early 1980s and the number of papers has increased markedly since then. Table 1 below illustrates the remarkable increase in papers published on both vertebrates and invertebrates by research staff since 1996 (B. Law *pers.com*).

Table 1: Fauna publications by NSW forestry research staff since 1976. Publications are split into 5 year intervals for vertebrates and invertebrates with separate listing for refereed and non-refereed publications (includes published internal reports).

Year	Vertebrates		Invertebrates	
	Refereed	Non-refereed	Refereed	Non-refereed
1976-80	0	4		
1981-85	14	9		
1986-90	13	11		1
1991-95	13	11	13	5
1996-2001	34	13	5	2
2001-02	14	2	8	

Wyn Rohan-Jones transferred to the National Parks and Wildlife Service in 1982 where he became Wyn Jones and was very much involved in the recognition of that amazing new genus of tree known as the Wollemi Pine, discovered in Wollemi National Park in1994. In 1984, I was also transferred out of the Research Division and into the Forest Inspectorate, so forgive me if I am not familiar with some notable events and people since then.

Communication and implementation of research results

There is a mutual need for experts in different disciplines to listen and adapt to each other's problems, learn to work together, and remember that organizations tend to change relatively slowly. I did feel for our wildlife ecologists because they were a small isolated group and there were communication problems with field staff and other non-research divisions in the organization. At the same time there is no doubt that the fauna experts did not always comprehend the problems that forest managers had to deal with as a result of their obligations under the Forestry Act and other Government directives. Thomas (1985,1986) gives an excellent North American perspective of this problem from the biologist's point of view.

In 1978, the Research Working Group on Forest Wildlife was formed under the umbrella of the Australian Forestry Council. This facilitated the communication of forest wildlife researchers on an Australian wide basis. In 1979, the Forestry Commission's Research Division organised a successful two day seminar involving the wildlife researchers and various field officers to discuss a range of issues including problems of communication. In 1981, the Forestry Commissioner, Dr.Wal Gentle, arranged for a brief external review of the wildlife research program by Professor Stan Gessel who was visiting from the University of British Columbia. I do not recall being aware of this review and the Research Division did not receive a copy of the review until mid-1983 by which time it was out of date. The Wildlife Research Unit published an in depth review of their work in 1985 (Shields and Kavanagh 1985).

The 1980s period also saw attempts by bureaucracy to pressure people to withhold data, to not interpret data, or not to express opinions. Harry Recher has stated that he had been subject to pressure not to air his views in public (Recher 1984). I understand this pressure may have come from the Commission. Unfortunately, such attempts at censorship of ideas may still arise from a variety of public sector sources (Recher *pers. comm.*)

The International Union of Forestry Research Organizations (IUFRO) held a useful workshop in Brisbane in 1984 on wildlife management in forests in the tropics and southern hemisphere (Kikkawa 1985). This workshop also emphasised the need for co-operation between biologists and managers. In an unpublished submission to that workshop authored by Curtin, Shields and Kavanagh we stated that:

> "Although there are excellent exceptions, some forest managers are not particularly aware of the wildlife resource in the forest, nor are they sensitive to their needs. On the other hand, some wildlife researchers are not aware of the problems faced by the multiple-use manager and may not understand why wildlife management is not always the highest priority. In a nutshell, the researcher may expect silviculture to be tailored to suit animals but the manager will expect wildlife guidelines to fit in with the available silviculture. The solution to this problem is improved interaction and communication between researchers and managers, particularly as more research and inventory data is generated."

Wildlife ecologists have often repeated this call for increased interaction (Davey and Norton 1990) and I have been informed that by the late 1990s, and in conjunction with the excellent training system established by the Wildlife Research Unit, most State Forest's field and professional staff knew and applied more wildlife knowledge than they did silvicultural knowledge (Bridges *pers. comm.*). This is a massive change.

Adaptive management in Eden

The Regional Forester in Eden during the 1970s and 1980s was Ross Dobbyns and there is no doubt that Ross was quite prepared to listen to well argued reasons for modification to management practices. And changes did occur. When integrated logging started in Eden there was insufficient road infrastructure to allow dispersal of logging. Initially, in 1969, harvesting units were up to 800 ha. They were reduced to 200 ha (compartment size) in 1972. However, after the 1972/73 wildfire a large contiguous area of forest damaged by high intensity fire was salvage logged, resulting in a large area of intensively harvested and burnt forest with associated impacts on fauna, aesthetics, hydrology, and soil erosion. In 1976, small coupe (15 ha) harvesting commenced with coupes harvested in an alternate pattern to improve aesthetics, hydrology and fauna conservation (although there was contention regarding the benefits to fauna conservation in relation to edge effects and the increased area to be roaded). These coupes were not subjected to post-harvest burning as regeneration of the drier forest types could be achieved without fire, but the logging debris did result in a widespread fire hazard. The alternate coupe system required a doubling of the road construction program, and reduced the area available for broad area hazard reduction burning, which was scheduled to take place in those older forest stands, not currently affected by logging. Bark heaps which accumulated on log dumps were burnt to remove the hazard but these long smouldering heaps were also a potential source of fire. The November 1980 wildfire originated from a bark heap that had been ignited in June 1980. Following the 1980 wildfire, the Commission critically reviewed the fire policy, adopting post-logging burning, the retention of seed trees and mechanical distribution of bark heaps back into the forest. To accommodate post-logging burning, coupe size was increased to an average size of 60 ha. A full description of these changes is given in Bridges and Dobbyns 1991 and I believe they are an example of adaptive management with relatively quick introduction of appropriate measures for improved forest management, including fauna conservation.

Not all of these changes were welcomed by the wildlife ecologists. My recollection is that Harry Recher was against the introduction of post-logging burning. These management changes, as well as the incidence of wildfire in experimental areas, means that the interpretation of research results and their extrapolation to later management situations is made more difficult. This difficulty was discussed in Richards *et al.* (1990).

The early research in Eden had quickly identified elements of the fauna that depended on "old growth" habitat and initially this was being provided by unlogged streamside reserves (originally set aside for hydrological reasons) and other areas considered uneconomical to harvest. Erosion control guidelines had been developing for some time and 80 m unlogged reserves along major streams were in place in Eden in 1971, although the size and distribution of these "filter strips" has been reduced as a result of continuing research.

Policies, plans and legislation for the provision of habitat 1974-97

In 1974 the Commission issued a general instruction on the "aesthetic and environmental aspects of road construction" and in 1977 the " Standard Erosion Mitigation Conditions" (prepared in collaboration with the then Soil Conservation Service) were adopted and became conditions attached to logging licences throughout the state. These were revised in 1984 and became "Guidelines". As discussed earlier, these guidelines required stream- side reserves to ameliorate soil erosion but they also provided useful habitat for fauna.

The Indigenous Forest Policy or IFP (Forestry Commission 1976) was very important in bringing a statewide cohesive approach to the planning and silviculture of the native forest. It contained a relatively rudimentary section on wildlife conservation. As a keen silviculturalist who placed much importance on improving the timber productivity of cut-over forest stands, the policy did have some disappointments (Curtin *et al.* 1991). Because it placed less emphasis on silvicultural treatment in more remote forests, the IFP resulted in many of these forests retaining structural diversity with a relatively high component of old non-commercial trees which provided habitat for hollow using fauna. Subsequently there was more emphasis placed on corridors and retaining trees within the harvested area to extend the habitat resource.

I believe the 1975 Nowra Management Plan (Forestry Commission 1975) was the first to introduce this principle by requiring the retention of five "reference trees" per ha. The plan recognised that intensive management for production of mining timber had simplified the structure of the forest and reduced its value as habitat. These reference trees were not necessarily hollow but they were expected to develop them over time. Similarly in 1977, the Kendall District on the mid-north coast introduced the retention of at least one old growth tree per ha (if available) in the simplified regrowth blackbutt forests in that area. Habitat (or "possum tree") retention commenced in the Eden area in 1979 at the rate of at least five trees per 15 ha. Virtually all management plans prepared after 1984 specified the retention of habitat trees, although the rate varied between Management Areas. It has now become standard practice to retain higher numbers (which varies with forest type) with 4-12 habitat trees/2ha and 4 -12 recruitment trees/ 2 ha retained. Recruitment trees are expected to replace the habitat trees over time.

Eden, in 1979, became the first Region to develop a formal wildlife policy. This was followed in 1980 when the Forestry Commission adopted a statewide policy. The main thrust was that the forest should be managed so that the overall diversity of existing species be maintained paying particular attention to forest dependent species and rare and endangered species. It was generally acknowledged that forest practices would affect local population size but it was important that all species should maintain viable populations at a regional level. A wildlife research policy was also developed at that time. There was considerable debate on the actual wording of this policy and there was a tendency for the senior managers to be quite conservative. The wildlife policy was further revised in 1987.

Management for forest fauna was also greatly assisted by the requirement for formal harvesting plans to cover individual operations, so that site-specific information could be used to protect habitat where desirable. These were first developed in Eden in 1977 and their use soon spread throughout the state. A forest zoning system (the PMP or Preferred Management Priority system), introduced in 1980, allowed the forest to be zoned for special uses including the provision of corridors and other wildlife habitat.

On a state-wide basis, the harvesting plan has developed more or less continuously and current plans consider the requirements of the Integrated Forest Operations Approval (IFOA); the specific conditions and prescriptions that are contained in the IFOA itself; and in the relevant licenses issued under the *Protection of the Environment Operations Act 1997*, the *Threatened Species Conservation Act 1995* and the *Fisheries Management Act 1994*. Area specific surveys for fauna are completed as part of the planning process. I note with some awe that the Terms of Licence under the Threatened Species Conservation Act for Eden amounts to 107 pages of rules and instructions and that the cost of pre-harvest survey in NSW amounted to $1.6 million during the year 2000/2001 (State Forests NSW 2002). Application of the various protocols plus other exclusions means that the harvested net area is only about 30-40 % of the total State Forest area. This reduction in the area disturbed by logging can lead to regeneration problems in the wet sclerophyll eucalypt forests, because logging intensity may not be sufficient to ensure satisfactory regeneration (Nicholson 1999).

Environmental Football – The Turbulent Years – 1980 - 1995

As the wildlife and other environmental research began to produce useable results and the Forestry Commission started (admittedly with a time lag) to implement a program of active conservation management, the process was overwhelmed by a variety of developments that virtually dominated the research and management

agenda. The Wildlife Research unit and regional research staff were often involved in gathering data related to new or ongoing environmental disputes. The resolution of these disputes often resulted in an increased area of conservation reserves.

Rainforest logging

Rainforest logging was a continuing debate. The Commission had already started to phase out general-purpose rainforest logging (Forestry Commission 1976), but progress was slow. The Border Ranges dispute commenced in 1972 and was "resolved" in 1978 after the Isaacs Inquiry. In 1978, the Terania Creek dispute near Casino saw the start of violent confrontation and sabotage. Similar disputes arose in the Black Scrub on the Bellinger River near Dorrigo, the Hastings River catchment near Wauchope, and Washpool State Forest near Grafton, leading to the production of the first Environmental Impact Statements under the new *Environmental Planning and Assessment Act 1979*, and subsequent litigation in the Land and Environment Court. Remarkably few of the decisions from litigation and Government Inquiries went against the Forestry Commission, but the continuing controversy culminated in the inevitable Rainforest Policy Decision of 1982 which was determined by the NSW government. This decision involved the transfer of 100 000 ha of rainforest and hardwood forest to the National Park system while ostensibly maintaining employment and providing alternative timber supplies to the industry. It "solved" the Border Ranges, Terania Creek, Washpool, Black Scrub and Hastings disputes. Ironically, Government commitments to supply rainforest timber (or substitutes) to industry led to renewed harvesting of less controversial rainforest areas where general purpose logging had already ceased. The cut of rainforest timber had decreased dramatically since 1982 although general purpose harvesting only ceased as recently as 1995.

Woodchips and old growth

In 1981, in the South-East forests near Eden, the catchment of the Tantawanglo Creek became the focus for the dispute over integrated harvesting, resulting in a new phase of hydrology research. An EIS for Wandella-Dampier, near Batemans Bay, was prepared in 1983. In the north (Casino), there was a dispute over the logging of old growth on the Blackbutt Plateau beginning in 1985. In 1987, the *Wilderness Act* was passed, remains of a Long-footed Potoroo *Potorous longipes* were found in a scat at Sheepstation Creek near Eden, and most of the Eden forests were nominated for the National Estate with consequent ramifications with respect to the issue of export licences for woodchips. This resulted in the setting up of a Joint Scientific Committee (JSC) on the South-East Forests to undertake biological surveys within these National Estate areas and to make appropriate recommendations to resolve the current conservation problems (Richards *et al.* 1990). The Committee had three representatives from the Forestry Commission (including myself) and three with university backgrounds, but Henry Nix was the only non-forester! The report was quite controversial (Recher 1990) and some biologists were outspoken in their criticism. Given the terms of reference and the time frame involved, I believe that the Committee did a good job under difficulties. I enjoyed working with the other members of the Committee and particularly enjoyed the application of Environmental Domain Analysis to the problem at hand under the guidance of Henry Nix. A large biological database was assembled which of itself has been of continuing use to fauna conservation.

Harris Daishowa displayed its second EIS under Commonwealth legislation in 1986 and a subsequent (1987) challenge by Jarasius in the Land and Environment Court required the Forestry Commission to also prepare an EIS under State Legislation, which was finally displayed in December1988 but not determined until 1991. Subsequently the Commission produced EISs for Eden in 1990, 1991, 1992 and 1994.

Other actions in the Land and Environment Court at this time involved areas such as Mistake (1989) near Kempsey, Mount Royal near Newcastle, Chaelundi near Dorrigo, North Washpool near Grafton (1990) and Way Way SF near Kempsey (1991). Experience in the Land and Environment Court led to the 1990 Forest Strategy which involved undertaking EISs for 15 areas containing old growth forest. This has resulted in a massive study of the biological resources and the impacts of forest harvesting, although the Strategy was overtaken by later events, including the Regional Forest Agreements (RFAs) and associated legislation. There has also been increased external regulation, particularly of harvesting operations, by other government departments, which generally regulate the management of flora and fauna, erosion and hydrology, and fisheries. All in all, there is little doubt that knowledge of the fauna resource on State Forest is more detailed and extensive than that available for conservation reserves.

Debates on impacts of forest practice on ecosystem processes and biodiversity

Forest managers need to examine the effects that forestry practices have on ecosystems and the processes that drive them. There is still a great deal to learn about forest impacts but a substantial body of information has been derived from the existing research. As stated earlier, this information is often interpreted in different ways depending on the values held by the interpreter. I have not kept up to date with all developments and the literature so forgive me if I have not mentioned significant new work in the discussion below. Mind you I have been a little amazed at the great amount of repetition which continues to be published, in the sense that the same data are reproduced in a variety of publications.

An excellent, comprehensive and objective review of the literature then available to the Resource Assessment Commission (RAC) was given in Lacey *et al.* (1990). The RAC (1992,1993) noted that the research base was far from adequate, that only 20% of the articles on impacts of forest practices contained original data and that there were considerable differences in the way people interpreted the results of research.

Forestry activities do affect ecological processes and there is debate on whether these processes can be maintained in the presence of disturbance activities such roading, logging, silviculture, burning, recreation and grazing (Dovers *et al.* 1994; Scotts 1994). However, ecologists do recognise the resilience of ecosystems to disturbance. In discussing "how to build and repair ecosystems" Westoby (1986) makes the important point that disturbance to the web of interactions between species in an ecosystem does not mean that species will become extinct, and that ecosystems are not as fragile as many people claim. Westoby notes that: "Ecologists have liked to believe that any change to such a complex web of interrelationships as an ecosystem could have ramifying, drastic and unpredictable effects. This has been a powerful argument to use against those proposing to take logs or fish from an ecosystem for the first time. But it is not true".

The positive effects of disturbance on biodiversity have also been recognised (Averill *et al.* 1995; Miller 1995) and most biological communities are always recovering from the last disturbance (Reice 1994). Disturbance is one of the principal mechanisms underlying the maintenance of species diversity. Most hypotheses predict the greatest number of species will occur at intermediate levels of disturbance (Horn 1974; Connell 1978; Petraitis *et al.* 1989). Admittedly, the aim of biodiversity conservation is not solely to maximize the number of species (Recher *pers. comm.*)

The Resource Assessment Commission (RAC 1992) noted the difficulty in examining impacts on an experimental basis, the variation in space and time of the impacts themselves, and the problems related to interpretation and human value systems. The Inquiry found "that logging is likely to increase the risk of extinction of some species, but received no evidence to suggest that increased risks present an immediate threat to the ecological processes on which forest systems depend." The RAC did come under criticism for not undertaking a more comprehensive review of these impacts (Lunney 1991).

The primary conflict over the use of the native forests has involved the extent to which forest practices have affected populations of plants and animals. Norton and May (1994) stated "there is now a substantial body of scientific information indicating that integrated forestry harvesting does result in significant detrimental impacts on eucalypt forest biodiversity." They considered that "harvesting that is extensive in space and time relative to the target forest ecosystems or habitat is not ecologically sustainable". Obviously it remains important to determine the severity and frequency of disturbance that can be sustained, but many scientists have not examined the relatively small percentage of a forest area that is disturbed each year and the proportion of the area with little or no disturbance at all. Norton and May (1994) did amaze me with their citation that "The koala is also threatened with extinction in NSW due, in particular to integrated forest harvesting (Norton and Saxon 1993)". I did agree with their statement that the central problem in the debate is the difference between scientific information and human values.

Scotts (1994) considered that the "possibility of forest ecosystem collapse looms large as we progress through the current and first intensive logging cycle". He argues that, although no animal extinction has yet been linked with forestry practices, the demonstrated decline in many forest-dependent species suggests a likelihood of extinctions at local, regional and national scales if current logging regimes continue. Of course there have been substantial changes to logging regimes prior to and since that statement was written, so I hope his depressing viewpoint has also changed.

As part of the forestry EIS program in NSW, comprehensive surveys of flora and fauna have been undertaken. The survey process has allowed non-experimental comparison of logged and unlogged habitat in many areas. In contrast to the pessimistic predictions of Norton and May 1994, results have indicated that although individual species were found to exhibit specific and variable responses to forestry disturbance, overall species richness remains high in forests that have been harvested for over 100 years (Drielsma 1992; Binns 1993).

There has been some criticism of prescriptions used to maintain biodiversity in the managed forest. Norton and May (1994) see the central role for biodiversity conservation in the CAR reserve system but state: "If enhanced off-reserve management is to be achieved then a number of changes to the design and implementation of forestry prescriptions and codes of practice in forest used for wood production are required. Many of the currently employed prescriptions are based on little more than intuition and guess work and have yet to be adequately tested."

Operational prescriptions do need to be based on good science and the application of ecological principles and the Forestry Commission did seek the guidance and opinion of many scientists in developing both previous and current prescriptions. This has been an appropriate application of the precautionary principle, as definitive research results are only just starting to become available. Under the RFA process, the new protocols have been determined by experts in other organizations. They are perhaps too conservative and may now need to be relaxed a little. Most importantly it is necessary to monitor biodiversity in both production forests and reserves over long periods in order to verify that the management of both is appropriate.

Forests outside the reserve system should continue to play an important complementary role in meeting conservation objectives, even though these forests will be available for the production of timber and other commercial uses in an ecologically sustainable way. The managed multiple use forest should be important in maintaining, through periodic harvesting, mechanical site disturbance and managed fire, a wide spectrum of tree ages and forest successional stages, and the suite of ecological processes and plant and animal diversity which can characterise the forests of a region. Because the multiple use forest will still contain examples of unlogged forest, there is the potential for a great diversity of habitats with an associated high level of biological diversity including plants and animals associated with the successional stages of ecosystem development.

Impact of fire

The impact of fire on forest ecosystems is an important topic of considerable scientific and community concern. Although it is generally accepted that Aboriginal burning affected vegetation, there is controversy as to the extent to which this alteration occurred. The debate has re-surfaced as a result of the requirement to conserve 15% of pre-European forest types in the CAR reserve system. The journals of the early European explorers refer to the open, park-like conditions in some areas, which could have resulted from a regime of regular low intensity fire, but again there is conflict over the interpretation of these accounts (Ryan 1993; Ryan *et al*. 1995; Benson and Redpath 1997; Jurskis 2000; Benson and Redpath 2001; Florence 2001). Other approaches using dendrochronology, palynology, and quantitative analysis of survey records are also proving to be useful (J.Dargavel *pers. comm.*)

Fire is an integral part of the sclerophyll forests of NSW and the vegetation has adaptive mechanisms to enable it to recover from fire disturbance (Noble and Slatyer 1981; Recher and Christensen 1981; Florence 1994). While the frequency of fire has the potential to alter the balance between obligate seeders and plants which regenerate vegetatively (Fox and Fox 1986; Nieuwenhuis 1987; Fox 1988), a number of evaluations of the effects of prescribed burning at the operational level have concluded that, provided a mosaic is maintained and the interval between fires is suitable, then existing communities are maintained (Christensen and Kimber 1975; Abbott and Christensen 1984;Christensen and Abbott 1989).

High intensity fire has been the natural method of regeneration of the moist sclerophyll forest and it continues to be used as a silvicultural tool to regenerate these forests following logging (Attiwill 1994).

Both wildfire and prescribed burning may have impacts on flora, fauna, soils, hydrology, grazing and cultural resources. A fire regime is characterised by the season, intensity, frequency and extent of the fires that occur. The responses of individual species of plants and animals to a particular fire regime will depend on their ecological characteristics and habitat requirements. Fauna are capable of surviving intense wildfire by the utilisation of unburnt refuge areas, despite high mortality during the fires and increased post-fire predation. Recovery of animal populations is related to the recovery of vegetation (Newsome *et al*. 1975; Recher and Christensen 1981; Christensen and Abbott 1989). There is a substantial literature on fire ecology in Australia. I have cited Gill *et al*. (1981), but I am advised there are more recent works of relevance now available. Many of the interactions are complex and the long-term effects of repeated fires on the forest ecosystem require continued research and monitoring. More recently, there are concerns about possible serious negative effects of long-term fire exclusion associated with the increasing occurrence of eucalypt dieback (Jurskis and Turner 2002). These concerns, including possible adverse changes to fauna populations resulting from the exclusion of fire, also need urgent evaluation.

The Forestry Commission established long-term studies on the effects of prescribed burning, commencing in 1968 (Van Loon 1969, Birk and Bridges 1989). These studies are difficult and expensive to maintain and require continuing support if they are to realise their full potential. One of the experiments (at Bulls Ground, near Kendall) has been used to study the effect of fire on ant populations (York 2000), and the results from the Eden study are currently under review (Bridges *pers. comm.*).

Some scientists have adopted specific positions, such as opposition to post-logging burning or frequent low intensity hazard reduction burning (Catling 1991), but it is still necessary to look at the overall mosaic which arises from operational burning on a larger scale rather than the smaller and more uniform results from experimental burning on small plots. I believe that on this larger scale, more appropriate and diverse mosaics can be deliberately created by using appropriate fire regimes. Nevertheless more investigations are required, particularly with respect to fire frequency. I would certainly be cautious about declaring wildfire as less harmful to fauna conservation than hazard reduction burning at this stage.

This section on fire was written before the disastrous wildfires of early 2003 had occurred (or finished). On rereading the material above, I think it still stands although some increase in emphasis may be needed.

Recent developments with sustainable forest management

Progress with Ecological Sustainable Development and Ecologically Sustainable Forest Management continued during the 1990s and up to the present. There has been the ESD Working Group Report on Forest Use (ESD 1991) and the Resource Assessment Commission inquiry (RAC 1992). These developments helped formulate the National Forest Policy Statement (NFPS 1992) which specified the creation of a comprehensive, adequate, and representative (CAR) reserve system, based on the reservation of 15% of the area of forest types which existed in 1750, the undertaking of comprehensive regional assessments (CRA), including socio-economic impacts, and finally the negotiation of regional forestry agreements (RFAs) between the Commonwealth and State Governments.

The strategies adopt the twin goals of economic development and ecological sustainability, but there remains great conflict on how these goals can be achieved. The NFPS has two important goals. These are:

- Conservation of all values that forests can provide for current and future generations.
- Development of an internationally competitive timber industry through the sustainable economic use of native forests and plantations.

In 1995, the NSW Government announced a Forestry Reforms package with the objectives of conserving high conservation old growth forest and wilderness, and the establishment of a viable internationally competitive timber industry. A Deferred Forest Agreement was made between

the Commonwealth and State Governments and the State Government established the Resource and Conservation Assessment Council (RACAC), to carry out an interim assessment to identify forest areas that may be needed for inclusion in the CAR reserve system. Difficulties in negotiating RFAs with the Commonwealth led to the *Forestry and National Parks Estate Act 1998*, which allowed the State Government to establish its own NSW Forest Agreements. Subsequently the Commonwealth and State Governments agreed to RFAs over most of the forest areas of NSW. These Agreements have resulted in a large increase in the National Park estate, a reduction in the area of forest available for timber production (approximately 1 million ha between 1969 and 1999), reduced wood production (with some compensation for the timber industry), increased royalty rates and a much increased emphasis on fauna conservation within the area managed by State Forests of NSW. For a more general (Australia wide) history of the development of the RFA process see Drielsma (1999); Althaus (1999); Davey *et al.* (2002).

During this period there was a dramatic change in silvicultural policy in NSW. The Indigenous Forest Policy was withdrawn in 1995. In 1996, State Forests stated that the "primacy of wood" was at an end and that management for objectives such as fauna conservation would rank equally and no longer be regarded as constraints to timber production (Nicholson 1999). American wildlife biologist Jack Ward Thomas has written some enlightening comments on constraints ("A constraint is a miserable thing to be") and the adversarial games sometimes played by forest managers and wildlife biologists (Thomas 1985,1986).

These recent and far reaching developments are continuing. Much of the cypress pine and other western NSW forests are undergoing a similar process at the present time. I am aware of the considerable level of dispute which accompanied the determination of which areas are to be included in the reserve system. Nevertheless the process used was at least based on science (Davey *et al.* 2002), although this was by no means perfect or unbiased and political decisions had to be made. However, it seems to me that with a substantial (although possibly not perfect) Comprehensive, Adequate and Representative reserve system now finally in place, combined with the active application of positive management procedures to maintain biological diversity within the remaining areas of State Forest, then surely the period of conflict between wildlife scientists and land managers must finally be over! How many times in the past has this been said. And yet when I peruse the April 2002 issue of the *Australian Zoologist* that Dan Lunney kindly sent me, I read his comments about the need to use words that arouse passion rather than the clinical term "biodiversity conservation" with some misgiving (Lunney 2002). On the other hand I was delighted to see the Opinion Piece in the same issue and had to agree with many (if not all) of Harry Recher's comments on challenges for nature conservation, although I note his belief that sustainable development is an oxymoron (Recher 2002). I certainly think it was unfortunate that the environmental movement concentrated the last 30 years on the easier and more emotional problem of forest conservation and virtually ignored the much greater and more difficult problem of dryland salinity. The environmental movement (and the RFA process) have also largely ignored the problems of fauna conservation on the private forest estate until recently, although there are arguments that this should have been the major focus of attention (Braithwaite 2003). Politically this will no doubt be much more difficult although the problem could be partially solved as the native forest timber industry gradually disappears. Nevertheless the first battles in this coming conflict have already started with the passing of the *Native Vegetation Conservation Act 1997* and some of the conditions being applied by Regional Vegetation Management Committees in the draft management plans. I note with concern that the logging or thinning of private forest falls under the definition of clearing within the *Native Vegetation Conservation Act 1997*.

Also of great concern to me is the 1998 NSW Government's Integrated Forest Operations Approval (IFOA) that regulates the type of silviculture that can be implemented in State Forests. For example, on the north coast there is a requirement to apply the single tree (self explanatory) or group selection system (where a number of adjacent sawlogs are removed in logging to create a gap in the canopy in which regeneration can proceed and develop with minimum competition from other plants). The IFOA applies a limit on the maximum gap size in the canopy to be created by logging and in which regeneration can then occur. The Government has stated that "95% of timber volumes are expected to come from single tree selection harvesting". This IFOA restriction is likely to inhibit the satisfactory regeneration of many of the moister eucalypt forest types such as Flooded Gum or associations of Tallowwood *E. microcorys* and Blue Gum *E. saligna* which require much larger openings in the canopy as well as substantial soil disturbance to ensure satisfactory regeneration (Van Loon 1966). This restriction indicates a complete lack of understanding of tree species and plant community patterns and their silvicultural attributes and ecology (Florence 1997, Bauhus 1999) and has been imposed in order to satisfy an unwarranted environmental demand for low disturbance logging in these forest types. Low intensity harvesting in these forest types is likely to dramatically alter the species composition of the stand, lower the future commercial value of the forest, and have substantial effects on future sustainability, including faunal biodiversity.

Even in compartments set aside for timber production, only part of the area is actually available for harvesting because of the application of various environmental protocols including the provision of habitat. Given that a substantial comprehensive, adequate and representative system of conservation reserves are now in place, there is a case for the re-examination of some protocols, to allow more economic harvesting and to ensure the satisfactory regeneration of the same plant species after logging.

Another concern with these developments is whether the native forest timber industry will be able to survive, let alone be dynamic and competitive. Even though substantial reductions in yield have been forecast, it may be necessary to degrade immature regrowth forest by logging such areas too early in their growth cycle just to satisfy unrealistic quota commitments in the short to mid-term.

Concluding Remarks

Having given my objective, unemotional review of the history of fauna conservation in the NSW State Forests, I will make (or repeat) a few more points, the first of which is known to raise the ire of many respected conservationists such as Dan Lunney and Hugh Possingham. I know the rest of my points will be well received!

1. I am proud that after all these years and many adverse forecasts there is still no record of the extinction of a native animal as the direct result of forest management practices. I do appreciate that adverse impacts occur but positive steps have been taken. Both scientific evaluation of these steps and long-term monitoring are still essential. In the mean time this is surely good news.
2. Now that the CAR reserve system is in place, its biodiversity must be monitored to ensure that the passive management practices are, in fact, maintaining biodiversity. The Criteria and Indicators of ESFM apply equally to National Parks (Reed1991).
3. Again, with the CAR system in place and substantial habitat protection protocols being implemented in State Forests, I now look forward to the environmental movement and some wildlife ecologists taking a more balanced approach to conservation issues involving off-reserve forest management. They have now achieved most of their objectives as specified in the 1991 edition of this book.
4. Long-term research and monitoring must continue, but remember that some old experiments were established in areas that were more highly disturbed than current practice. Please continue to take this into account.
5. I believe all land managers in NSW need to pay more attention to controlling predation by introduced species such as the fox, cat and dog.
6. I agree with the concept that conservation needs to be integrated at the landscape level, but I also see major difficulties in achieving this in a politically and socially acceptable way. We need a few more blueprints, Harry.
7. I am concerned that under current silvicultural and fire constraints, the wet sclerophyll forest will not regenerate to the existing species composition. We face the possibility that some 1750 forest types will diminish. Mind you we may have more rainforest.
8. I believe that the socio-economic impacts of the RFA process have not been properly recognised, and a major objective of the National Forest Policy Statement (a competitive and viable native forest timber industry) will not be achieved. Call me a cynic, but it might not be long for the recent boom in eucalypt plantations to come under serious attack by the environmental movement.
9. I want to see more and more published photographs of the forests in the Eden and other areas which we "destroyed" in the 1970s. They must be looking nice now and I understand they now have some resident fauna too.
10. Perhaps I have said enough. Objectivity is pretty tiring!

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